NASA SCIENCE MISSION DIRECTORATE

Earth Science Division
Applied Sciences Program
Carbon Management Program Element
FY2007-2011 Plan

FINAL DRAFT

Date: 11/6/2006

Expanding and accelerating the realization of economic and societal benefits from Earth system science, information, and technology

NASA Earth Science Division - Applied Sciences Program

Carbon Management Program Element

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The Applied Sciences Program websites contain additional information about the program and this program element:

Applied Sciences Program:	http://science.hq.nasa.gov/earth-sun/applications
Carbon Management Element:	http://science.hq.nasa.gov/earth-sun/applications/theme4.htm
Project Tracking & Reporting	http://aiwg.gsfc.nasa.gov

NASA Science Mission Directorate – Applied Sciences Program

Carbon Management Program Element Plan: FY 2007 - 2011

I. Purpose and Scope

The NASA Applied Sciences Program collaborates with partner organizations to enhance the application of NASA Earth science research results to serve issues of national priority. The desired outcome is for partner organizations to use project results, such as prototypes and benchmark reports, to enable the sustained, operational use of Earth science products and enhance their decision support capabilities.

Carbon management reflects decisions by managers that influence carbon emissions or sequestration and often involves complex interactions between natural and anthropogenic processes. In theory, any practice that influences the carbon cycle could be considered carbon management, but practical applications tend to focus on management that leads to carbon sequestration and thus a reduction in atmospheric CO2. The Applied Sciences Program extends the use of NASA Earth science observations, measurements, predictive models, and research results in carbon cycle science to enhance the decision support tools of NASA's operational partners – agencies and organizations – with mandates to monitor and regulate carbon emissions as well as encourage carbon sequestration, i.e., to manage carbon.

The US Administration launched the Climate Change Research Initiative (CCRI) in 2001 to address specific climate change issues. The Climate Change Science Program (CCSP) is the primary implementation of the CCRI. NASA is involved in various elements of the CCSP including research to decrease uncertainties in our understanding of the carbon cycle. NASA carbon cycle research is directed by the Carbon Cycle and Ecosystems focus area in the research program of the Earth Science Division.

The Carbon Management Program Element (CMPE) matches needs for information upon which to base decisions on emissions and sequestration of carbon with the observations, measurements, and output from predictive models using data from NASA Earth observing systems, such as Terra/Aqua, Aura, SeaWiFS, and the forthcoming Orbiting Carbon Observatory (OCO). Data and data products from these systems provide information to measure and monitor carbon sequestration in terrestrial, lacustrine and oceanic environments and the flux of carbon among these environments and the atmosphere. The CMPE also evaluates the output from NASA carbon cycle research for potential enhancements to the decision making processes of organizations with operational responsibilities for carbon management.

Projects sponsored through the CMPE build toward an operational carbon management decision-support system that informs resource managers and policy makers of the current state of the distribution of carbon sources and sinks and evaluates near-term and long-term potential for mitigation given a variety of management scenarios. In developing a science-based carbon management decision-support system, knowledge of the carbon cycle is incorporated into an application that can assist federal agencies (e.g., the US Department of Agriculture (USDA), Department of Energy (DOE), Environmental Protection Agency (EPA), and the US Geological Survey (USGS)) and state, local and commercial entities, fulfill their operational mandates to manage carbon in the environment.

To be integrated with other current carbon cycle science programs, the CMPE draws upon, and contributes to, other program elements in the Applied Sciences Program in addition to other programs in the federal

government. The CMPE works closely with the Carbon Cycle and Ecosystems Focus Area in the Research Program of the Earth Science Division and with the Ecological Forecasting, Water Management, Air Quality, Disaster Management and Homeland Security Program Elements in the Applied Sciences Program. Activities of the CMPE are integrated with the Carbon Cycle Interagency Working Group (CCIWG), the Synthesis and Analysis Report (SAR) 2.2 Agency Executive Committee (the group responsible for interagency compilation of the prospectus for the SAR 2.2 report and management of the North American Carbon Program (NACP)), the focus area working group for carbon of the NASA/USDA Interagency Working Group for Applied Science Applications, and International Working Group on Earth Observations (IWGEO.) The CMPE is implemented through partnerships and competitive solicitations. Operational agencies are key members in these partnerships: establishing requirements for decision support systems, monitoring progress, incorporating results into operational procedures, and on-going, operational use of the tools and systems based on NASA Earth observations, models and research results.

II. Objectives: FY2007-2011

The Carbon Management Program Element (CMPE) seeks to maximize the benefit of observations and measurements from NASA Earth observing systems and output from NASA predictive models in decision support systems and tools used by agencies and organizations responsible for policy and resource decisions related to carbon emissions and sequestration – from local to global scales. Prior to FY07, the carbon management program element focused on support for tools, such as CQUEST and TOPS, that have provided users with access to data products and model predictions on terrestrial processes. During the next five years the CMPE will focus on integrating those tools and NASA data products and model outputs into decision support processes, and will describe the improvements in performance of these decision making tools in benchmark reports. By 2011, the CMPE expects to document multiple examples of enhanced decision making tools at the international federal, regional and state levels. Beginning in FY07, the CMPE will evaluate the contribution and potential contribution of new NASA Earth science observations and measurements (e.g., CloudSAT, CALIPSO, OCO) for carbon management. The new capabilities will lead to a new focus in the CMPE on atmospheric observations and measurements. The CMPE will also assist as applicable in the transition from the current suite of land observation instruments such as ETM+ and MODIS to their operational equivalents – LDCM and VIIRS. Continuity of these observations is critical to the success of the CMPE.

The CMPE will continue to collaborate with the NASA Earth science research program, other elements in the Applied Sciences Program and national and international programs addressing carbon cycle dynamics and climate change. For example, the CMPE works closely with the Carbon Cycle and Ecosystems Focus Area of the Earth Science Division. Projects supported by CMPE address issues and use models common to the terrestrial ecology and biodiversity research elements in the Earth Science Research Program and the ecological forecasting, agricultural efficiency, invasive species, water resources and air quality elements of the Applied Sciences Program. Carbon management is a recognized topic within the carbon cycle element of the Climate Change Science Program, and the CMPE manager is an active participant, as a representative of NASA, on the Carbon Cycle Interagency Working Group. Carbon management is a multi-agency activity, and the CMPE will continue to form partnerships with other federal agencies, (USDA, EPA, DOE, DOI etc.) to address carbon management decision making processes. The CMPE also participates in the US Group on Earth Observations and on related groups and tasks supporting the Group on Earth Observations System of Systems.

2007 Goals...

2007 Goals...

Near-term Objectives (FY07-FY10)
2008

2008 Goals...

2009

2009 Goals...

2010

2010 Goals...

2011

2011 Goals...

III. Carbon Management Issues, Related Research, and Decision Support Tools

Potential Carbon Management Issues: FY07-FY11
Program management activities and participation in CCSP/CCTP:

1. Headquarters:
- Participation in carbon cycle working group of the CCSP.
- Participation in the sequestration working group of the CCTP.
- Identification of collaborative projects with USDA working through the NASA/USDA Interagency Working Group and the USDA Remote Sensing Coordinating Committee.
- Member - Carbon Cycle Interagency Working Group
- Contribute to planning, implementation and management of the North American Carbon Program.

2. Ames
- Participate in interagency (USDA, DOE, EPA) Greenhouse Gas Accounting Rules and Guidelines Working Group
- NACP Tier three Site Measurement Guidelines working group.

3. Fellowships:
- NASA Fellowships for the period FY2002 through 2006 with potential impact on the carbon management

Carbon Management-related Research

The Coastal Management website contains a list of coastal-related research projects that the NASA Earth Science Division has supported. These projects provide insight into emerging research directions, knowledge, capabilities, and products.

In addition, the Applied Sciences Research Knowledge Base provides a venue to search for specific terms and results.

Priority Decision Support Tools

The Carbon On Line Estimator (COLE) is used by the USDA Forest Service and the National Council for Air and Stream Improvements (NCASI). The DST combines FIA and ecological data to develop carbon accounting estimates for reporting under section 1605(b) of the Energy Policy Act of 1992 and other purposes.

IV. Project and Activities

All National Applications Program Elements authorize peer-reviewed projects to support each element's goal and objectives. To secure funding and authorization to undertake activities supporting NASA and the Applied Sciences Program, project teams are responsible for developing project plans and managing the activities. The project plans specify the Earth-Sun observations, models, and other research results to extend to decision support tools as well as the activities to produce appropriate deliverables. The plans integrate contributions from appropriate the partners, NASA Centers and other contributors from the community of practice. Projects are expected to extend the benefits of NASA research results to the maximum extent possible, including the use observations from sensors on: Aura, Terra, Aqua, TRMM, NPP, NPOESS, Hydros, Topex, Jason, OCO and Aquarius.

A. Solicited Projects

The Applied Sciences Program utilizes full and open competitions to fund proposals from the community to contribute the Agency's objectives. This implementation strategy will continue to be critical part of extending the benefits of NASA Earth System Science research results and contributing to the improvement of future operational systems. The Program has participated in providing opportunities to the community in recent solicitations, including REASoN, Decisions 2004, and Decisions under ROSES. The proposals related to this National Applications Program Element that have been funded under these solicitations are described in Section V.D. Program Element Projects.

Project: Linking Landscape Scale Carbon Monitoring and Forest Management — Carbon Cycle Science 04

The purpose of this project is to assess the potential for MODIS, Landsat and carbon modeling results to improve the performance of the USDA/Forest Service's Forest Inventory and Assessment (FIA) process used in to improve the accuracy and reduce the cost of reporting to greenhouse gas registries and markets, and improve periodic estimates of U.S. forest carbon stocks for carbon management in forests. .

This project will use NASA data (MODIS), models (CASA), and decision support tools (CQUEST) to enhance the information available to USDA, DOE and the general public, on carbon stocks and sequestration potential in forests of varying age and composition. The enhancements will be evaluated by USDA in the 1605(b) greenhouse gas registry program.

Budget ($K)

FY07	379
FY08	224
FY09	0
FY10	0
FY11	0

Project Monitor/ Center	*Other NASA Centers*	*Timeframe*	*Partners*
Ed Sheffner HQ	ARC	FY05 - FY07	USDS/FS, CSUMB, CSU, NASA/ARC

Principal Investigator(s) *Richard Birdsey USDA/Forest Service*

Earth Science Products

mission: *Terra, Aqua*
sensor: *MODIS; LIDAR; Hyperion*
products:
models: *CASA*

Deliverables

Description	*End Date*	*IBPD Metric #*
Evaluation Report	6/1/2007	
Verification & Validation	12/1/2007	
Benchmark Report	6/1/2008	
Complete initial estimates of	12/1/2006	
Link models to multiscale data sets	12/1/2006	
Link models to multiscale data	11/1/2006	
Evaluation of existing Forest	2/1/2008	

Other Apps.

Agricultural efficiency, invasive species, water management, air quality, disaster management

Notes:

This work is part of the North American Carbon Program. Progress will be evaluated in FY07 regarding FY08 funding.

Notes for fields not available in ASPIRES:
We are integrating intensive ground-based measurements, remote sensing, and modeling at seven landscape-scale research sites across the U.S. to estimate carbon stocks and fluxes for forest carbon pools. As part of the North American Carbon Program, this study is intended to tie the spatially extensive, but coarsely resolved, measurements made through remote sensing and forest inventory to the spatially intensive and highly resolved measurements made at intensive monitoring sites such as the AmeriFlux network. Each study site consists of a diverse landscape that reflects the effects of natural disturbances and/or forest management activities on carbon stocks and productivity. To demonstrate the relevance of this work to land managers, we are evaluating how this information can improve decision support tools for estimating and reporting carbon stocks and changes in carbon stocks. The main products of this research include precise statistical estimates and maps of carbon stocks and productivity for a variety of forest landscape conditions; improved process models at ecoregion and stand scales; and decision-support tools for land managers interested in carbon management. We will estimate NPP and NEP for managed or disturbed tree stands in various stages of development, which will improve the ability of land managers to update or project stand-level inventories of carbon stocks for project evaluation and reporting to greenhouse gas registries. Reference data from these sites can be used by the scientific, policy, and land management communities. If successful, this project may evolve into a larger network of landscape-scale monitoring sites.
the USDA/Forest Service
CQUEST (based on NASA-CASA model); COLE (Carbon OnLine Estimator for 1605(b) reporting); FORCARB (for U.S. greenhouse gas inventory)
improve the accuracy and reduce the cost of reporting to greenhouse gas registries and markets, and improve periodic estimates of U.S. forest carbon stocks
carbon management in forests.

Project: Decision Support for Loblolly Pine Carbon Management: From Research to Operations — ROSES 04

The purpose of this project is to assess the potential for MODIS EVI and Landsat to improve the performance of industrial and non-industrial provate forest land owners's LobDST, CQUEST, and COLE used in management of commercial and private forest land for carbon sequestration.

This project will apply products from NASA observations (MODIS and Landsat) and models (CASA) to enhance three decision support tools (LobDST, CQUEST and COLE) used by private land holders and the forest industry to reduce uncertainties regarding predicting and monitoring carbon sequestration in privately held forested land.

Budget ($K)

FY07	652
FY08	552
FY09	0
FY10	0
FY11	0

Project Monitor/ Center	*Other NASA Centers*	*Timeframe*	*Partners*
Vern Vanderbilt ARC		FY06 - FY08	Vir. Tech U., NCASI, CSUMB, NASA/ARC

Principal Investigator(s) *Randy Wynne -VTU, Chris Potter - ARC*

Earth Science Products

mission: *Terra, Aqua, Landsat 7*
sensor: *ASTER, MODIS, ETM+, AVHRR, SRTM,*
products: *NDVI, EVI, etc.*
models: *CASA, PTAEDA, FASTLOB, FORCARB*

Other Apps.

Agricultural efficiency

Deliverables

Description	*End Date*	*IBPD Metric #*
Evaluation Report	12/1/2006	
Verification & Validation	12/1/2007	
Benchmark Report	2/1/2009	

Notes: Award is shared with C. Potter at NASA/ARC

Project: Projections of Land Use Change and the Carbon Cycle — Carbon Cycle Science 04

The purpose of this project is to assess the potential for MODIS and Landsat land cover, surface albedo, land use change to improve the performance of EPA's ObjECTS MiniCAM used in evaluation of greenhouse gas mitigation options for technology options for carbon management.

This project will use NASA data and model outputs bsed on terrestrial observation systems to improve long term projections of emissions and sequestration of CO2, CO and CH4 due to differences in land use. The model outputs from this project will be evaluated by EPA in an analysis of economic consequences of different greenhouse gas mitigation options.

Budget ($K)

FY07	142
FY08	81
FY09	90
FY10	0
FY11	0

Project Monitor/ Center	*Other NASA Centers*	*Timeframe*	*Partners*
Ed Sheffner HQ		FY05 - FY09	PNNL, EPA, Penn State U., U. of Illinois, Univ. of

Principal Investigator(s) *Steven Smith - PNNL/JGCRI*

Earth Science Products

mission: *Terra, Aqua, Landsat*
sensor: *MODIS, TM, ETM+*
products: *land cover characteristics, land-cover history,*
models: *ObjECTS MiniCAM*

Deliverables

Description	*End Date*	*IBPD Metric #*
Progress Report	3/1/2007	
Progress Report	3/1/2008	
Evaluation Report	6/1/2007	
V and V of carbon model output	11/1/2008	
Benchmark EPA usage	12/1/2009	

Other Apps.

Agricultural Efficiency
Ecological Forecasting

Notes:

Awarded under the carbon cycle science solcitation of 2004. Project is cofunded with the NASA Research Program. Progress will be evaluated in FY07 regarding funding in FY08 and FY09.

Missing fields in ASPIRES
NASA Research Results: Satellite data products: vegetation cover (), agricultural areas, built-up areas, land-cover changes, surface albedo; Products derived from satellite data and NASA earth science research tools: historical land-use changes (Ramankutty and Foley 2002; Hurtt et al 2006), carbon stocks and NPP (CASA, VEGAS, TEM).
Partner Organization/ Agency: Environmental Protection Agency (EPA)
Decision Support Tool: ObjECTS MiniCAM
Specific improved management analyses and actions/ decisions: Allow integrated analysis of the carbon and economic conewquences of different greenhouse gas mitigatio options using consistent, validated data sets
Specific Management/ Policy Issue: Carbon management and interaction with other technology options (e.g. CCTP), carbon-cycle uncertainty, and North American carbon sequestration options within a consistent global context.

Project: Decision Support for Carbon management Across the US Corn Belt | Carbon Cycle Science 04

The purpose of this project is to assess the potential for MODIS, ASTER, Hyperion, ETM+ to improve the performance of USDA/ARS's EPIC, Century used in agricultural practices for carbon sequestration for carbon management in agricultrual land.

This projects will enhance tools to assess the economic and environmental impacts of management decisions on crop yield and carbon sequestration by using NASA observations, etc., to 1) establish a baseline for soil carbon across a section of the US Corn Belt; 2) verify and validate NASA Earth observation products that can distinguish soil tillage intensity based on amount of crop residue cover; 3) apply the EPIC-Century model to assess soil carbon sequestration and crop yield for various agricultural practices; and 4) enhance a DSS for carbon management for evaluation by operational agencies in USDA.

Budget ($K)

FY07	224
FY08	0
FY09	0
FY10	0
FY11	0

Project Monitor/ Center	*Other NASA Centers*	*Timeframe*	*Partners*
Vern Vanderbilt ARC		FY05 - FY07	USDA-ARS, NASS, NRCS; SSAI

Principal Investigator(s) *Paul Doraiswamy - USDA/ARS*

Earth Science Products

mission: *Terra, Aqua, EO-1, Landsat*
sensor: *MODIS, ASTER, Hyperion, ETM+*
products: *Daily reflectance products*
models: *EPIC, Century*

Other Apps.

Agricultural Efficiency

Deliverables

Description	*End Date*	*IBPD Metric #*
Final report on DST potential	2/1/2008	

Notes: Awarded under the carbon cycle sciecne solcitation of 2004.

Project: Accounting for CO2 Fluxes in Agricultural Lands — Carbon Cycle Science 04

The purpose of this project is to assess the potential for MODIS-derived EVI to improve the performance of USDA-NRCS and EPA's COMET-VR used in carbon sequestration in agricultural systems for carbon accounting in volutary reporting system.

This project will enhance the quantification of CO2 fluxes freom agricultrual lands by using NASA data products (MODIS), models (CASA), and decision tools (CQUEST.) . The project will improve the performance of the USDA/NRCS VRGG-COMET tool as part of the 1605(b) process for greenhouse gas reporting.

Budget ($K)

FY07	80
FY08	275
FY09	250
FY10	0
FY11	0

Project Monitor/ Center	*Other NASA Centers*	*Timeframe*	*Partners*
Vern Vanderbilt ARC		FY05 - FY09	USDA/CSREES, NRCS,

Principal Investigator(s) *Stephen Ogle - Colorado State Univ.*

Earth Science Products

mission: *Terra, Aqua*
sensor: *MODIS*
products: *EVI*
models: *CASA and Century*

Other Apps.

Agricultural Efficiency
Ecological Forecasting

Deliverables

Description	*End Date*	*IBPD Metric #*
Progress report	5/1/2007	
Progress Report	5/1/2008	
Evaluation Report	6/1/2008	
Verification & Validation	6/1/2009	
Benchmark Report	4/1/2010	

Notes: Awarded under the carbon cycle science solcitation of 2004. Cost shared with USDA/CSRESS. CRESS is the primary funder through FY07. Porgress will be evaluated in FY07 regarding funding in FY08 and FY09.

Project: Spatially Explicit Full Carbon and Greenhouse Gas Accounting at the Regional to National Scale

Carbon Cycle Science 04

The purpose of this project is to assess the potential for Landsat TM and ETM+ to improve the performance of DOE's POLYSYS used in location and magnitude of carbon fluxes for carbon management in agricultural lands.

Thsi project assesses the potential of Landsat data to affect the estimate of carbon flux from agricultural lands and guage the socio-econmic impact of that information using the University of tennessee POLYSYS model. The model output has the portential to impact a number of USDA and DOE programs on carbon management.

Budget ($K)

FY07	200
FY08	
FY09	
FY10	
FY11	

Project Monitor/ Center	*Other NASA Centers*	*Timeframe*	*Partners*
Ed Sheffner HQ		FY05 - FY07	DOE/ORNL, U. of Tennessee

Principal Investigator(s) *Tristam West - ORNL*

Earth Science Products

mission: *Landsat*
sensor: *TM, ETM+*
products: *Cropland data layer*
models: *POLYSYS*

Other Apps.

Agricultural
Efficiency
Ecological
Forecasting

Deliverables

Description	*End Date*	*IBPD Metric #*
Progress Report	3/1/2007	

Notes: FY07 is last year of funding under original award. Program element anticipates funding in FY08 and FY09 leading to benchmark report based on progress to date. Out year funding listed under directed projects.

Project: North American Forest Distrubance and Regrowth — Carbon Cycle Science 04

The purpose of this project is to assess the potential for Landsat historical record to improve the performance of USDA Forest Service FIA's FIA processes used in spatially explicit assessment of habitat change for management of carbon stocks as part of forest management.

This project will apply current Landsat data and the 30 year archive of Landsat data to characterize forest disturbance and recovery in the US for use by the USDA/Forest Service in its Forest Inventory and Assessment (FIA) for carbon management, and by all the agencies participating in the North American Carbon Program (NACP).

Budget ($K)

FY07	246
FY08	375
FY09	375
FY10	
FY11	

Project Monitor/ Center	*Other NASA Centers*	*Timeframe*	*Partners*
Ed Sheffner HQ	GSFC	FY05 - FY09	Univ. of Maryland, GSFC, USDA/FS Oregon State U.

Principal Investigator(s): *Sam Goward - UMd; Jeff Masek - GSFC; Warren Cohen - Oregon State Univ.*

Earth Science Products

mission: *Terra, Aqua, Landsat*
sensor: *MODIS, ETM+*
products: *Forest land cover, condition and change*
models:

Deliverables

Description	*End Date*	*IBPD Metric #*
Progress Report	2/1/2007	
Project evaluation prior to	9/30/2007	
Evaluation Report	12/1/2007	
Verification & Validation	12/1/2008	
Benchmark Report	12/1/2009	

Other Apps.

Agricultural Efficiency
Ecological Forecasting
Disaster Management

Notes: Funding shared with ESD research program. Project uses output from the LEDAPS project also co-funded by research and the CMPE. Progress will be evaluated in FY07 regarding funding in FY08 and FY09.

Project: Global Land Cover Facility — REASoN

The purpose of this project is to assess the potential for Landsat, Terra, Aqua, SRTM data products to improve the performance of multiple agencies and other users's used in for .

This project makes data a nd data products from MODIS, SRTM and other sources available to the community through the Global Land Cover Facility at UMd. data are used regularly in carbon management and other program elements.

Budget ($K)

FY07	0
FY08	
FY09	
FY10	
FY11	

Project Monitor/ Center	*Other NASA Centers*	*Timeframe*	*Partners*
Ed Sheffner HQ		FY04 - FY07	University of Maryland

Principal Investigator(s) *John Townshend - UMd*

Earth Science Products

mission: *Landsat, Terra, Aqua, SRTM*
sensor: *ETM+. MODIA, SRTM*
products: *land cover change for Paraguay; VCC, VCF,*
models: *SVM land cover change automation, in*

Deliverables

Description	*End Date*	*IBPD Metric #*
Final Report	2/1/2007	

Other Apps.

Agricultural efficiency, invasive species, ecological forecasting, coastal management, etc.

Notes:

Project augmented through January 1, 2007 with funds from research and data management programs in ESD.
Fields not available in ASPIRES:
NASA Research Results:
(1) MOD44C used for NDVI, ASTER tasked for World Heritage Sites, plus ASTER accessed from data pool for CARPE project, Landsat-7 for the UN-DCP (3) MODIS MRT tool used for MOD44A, MOD44B, NDVI
Partner Organization/ Agency:
The GLCF receives data donations from many groups around the US and the world. The science information available at the GLCF online is used by many levels of user worldwide. We do not, however, track who is accessing the archive, so that users feel they are not being monitored. We believe this promotes wider use of these critical data sets.

Additional deliverables:
Reprocessing of SRTM into multiple formats and filled level products
Data & Products web pages standardized and data set citations provided
Ingestion of many additional products
Customer Service Emails answered since October 1, 2006 = 1059.
Advisory Council Meeting November 2005

Project: Roses II Ocean Carbon solicitation

The purpose of this project is to assess the potential for NASA Research Results to improve the performance of Partner 's used in for .

Budget ($K)

FY07	
FY08	500
FY09	500
FY10	500
FY11	

Project Monitor/ Center	*Other NASA Centers*	*Timeframe*	*Partners*
Ed Sheffner HQ	GSFC, ARC, SSC	FY08 - FY10	

Principal Investigator(s)

Earth Science Products

mission:
sensor:
products:
models:

Other Apps.

Deliverables

Description	*End Date*	*IBPD Metric #*

Notes:

Project: ROSES III-V for Carbon Management

The purpose of this project is to assess the potential for to improve the performance of 's used in for .

Budget ($K)

FY07	
FY08	
FY09	500
FY10	1000
FY11	1500

Project Monitor/ Center	*Other NASA Centers*	*Timeframe*	*Partners*
Ed Sheffner HQ		FY09 - FY11	

Principal Investigator(s)

Earth Science Products

mission:
sensor:
products:
models:

Other Apps.

Deliverables

Description	*End Date*	*IBPD Metric #*

Notes:

Project: Carbon Cycle Science solicitation

The purpose of this project is to assess the potential for NASA Research Results to improve the performance of Partner Organizations's Decision Support Tools used in Carbon Managment for Climate Change Policy Issues.

Anticipate new carbon cycle science solicitation with funding from research for carbon management.

Budget ($K)

FY07	
FY08	1000
FY09	1000
FY10	1000
FY11	?

Project Monitor/ Center	*Other NASA Centers*	*Timeframe*	*Partners*
Ed Sheffner HQ		FY08 - FY12	USDA, EPA, NOAA, USGS

Principal Investigator(s)

Other Apps.

Earth Science Products

mission:
sensor:
products:
models:

Deliverables

Description	*End Date*	*IBPD Metric #*

Notes:

Project: Analysis of ecosystem processes for NACP using satellite data and simulation models — NACP ROSES

The purpose of this project is to assess the potential for observations (MODIS, AMSR) and models (TOPS) to improve the performance of NACP participants's used in regional to continental carbon fluxes for verification and monitoring of carbon management projects.

For carbon management, this project will provide regional and national estimates of daily carbon fluxes at a 4km grid. This information will be critical for evaluating the effectiveness of carbon sequestration projects and monitoirng carbon fluxes.

Budget ($K)

FY07	294
FY08	284
FY09	294
FY10	
FY11	

Project Monitor/ Center	*Other NASA Centers*	*Timeframe*	*Partners*
Ed Sheffner HQ	ARC	FY07 - FY09	CSUMB

Principal Investigator(s) *Rama Nemani - NASA/ARC*

Earth Science Products

mission: *Terra, Aqua*
sensor: *MODIS, AMSR-E*
products: *carbon fluxes nationally at 4km*
models: *Biome-BGC, CASA*

Other Apps.

Ecological forecasting

Deliverables

Description	*End Date*	*IBPD Metric #*
Initial TOPS run for N. America	9/30/2007	
Uncertainty estimates	9/30/2008	
Validation of model results	6/1/2009	
Final TOPS implementation for N.	9/30/2009	

Notes:

B. Directed Projects

The program supports directed projects to serve issues of critical strategic and tactical importance, including near-term opportunities with potential for high-return in developing relationships with partner organizations and where timeliness is critical to maintain.

Project: LEDAPS-Forest Disturbance — Directed Project

The goals of this project are to (i) adapt the MODIS MODAPS processing system for use with Landsat imagery; (ii) generate decadal surface reflectance products for Landsat MSS, TM, and ETM+; (iii) map disturbance rate and type (e.g. fire, logging, other) from the Landsat surface reflectance data, and (iv) work with Applied Science Partners to integrate the LEDAPS products and processing system into decision support systems for carbon management and forest inventories. The project will rely primarily on the NASA/EarthSat SDP GeoCover product, which affords cloud-free, orthorectified coverage for North America for decadal epochs centered on 1975, 1990, and 2000. The project will be completed within 4 years. The disturbance maps will be used within carbon accounting and biogeochemical models, while the surface reflectance data will be used within the US Forest Service Forest Inventory Analysis (FIA) program.

Budget ($K)

FY07	283
FY08	0
FY09	0
FY10	0
FY11	0

Project Monitor/ Center	*Other NASA Centers*	*Timeframe*	*Partners*
Ed Sheffner HQ	GSFC	FY04 - FY07	USDA-FS

Principal Investigator(s): *Jeff Masek - GSFC*

Earth Science Products

mission: *Terra, Aqua, Landsat*
sensor: *AVHRR, MODIS, Landsat,*
products:
models: *TOPS*

Other Apps.

Agricultural Efficiency
Ecolgical Forecasting
Disaster Management

Deliverables

Description	*End Date*	*IBPD Metric #*
Final report on LEDAPS	9/30/2007	

Notes: Project is co-funded by ESD research

Project: The Utility of OCO Data to Enhance Decision Support Tools

Develop a rapid prototype model that quantifies fluxes of carbon over regional spatial scales, ranging from ecosystems to countries, using atmospheric CO2 profiles generated by the NASA-CASA model sampled in a manner identical to how the Orbiting Carbon Observatory (OCO) will sample the atmosphere.
a. Produce a series of carbon flux "snapshots" for specific times and regions, providing an empirical method to quantify surface processes from satellite observations of CO2.
b. Compare these results to carbon fluxes calculated for the same time and place using CQUEST (Carbon Query and Evaluation Support Tools), which is based on the NASA-CASA model driven by vegetation propertied measured by the AVHRR (Advanced Very High Resolution Radiometer) and MODIS

Budget ($K)	
FY07	25
FY08	0
FY09	0
FY10	0
FY11	0

Project Monitor/ Center	*Other NASA Centers*	*Timeframe*	*Partners*
Ed Sheffner HQ	JPL, ARC	FY06 - FY07	

Principal Investigator(s): *David Tralli*

Other Apps.

Earth Science Products

mission: *Terra, Aqua*
sensor: *MODIS*
products:
models: *CASA, CQUEST*

Deliverables

Description	*End Date*	*IBPD Metric #*
Rapid prototype model	7/1/2007	

Notes: Charles Miller is technical PI. Work in association with C. Potter at NASA/ARC

Project: Augmentation for Forest Disturbance and Re-growth

Augmentation to project to accelerate evaluation of inpact on FIA

Budget ($K)	
FY07	50
FY08	0
FY09	0
FY10	0
FY11	0

Project Monitor/ Center	*Other NASA Centers*	*Timeframe*	*Partners*
Ed Sheffner HQ	GSFC	FY07 - FY07	UMd, USDA Forest Service

Principal Investigator(s): *Jeff Masek, - GSFC, Sam Goward UMd*

Other Apps.

Earth Science Products

mission: *Landsat*
sensor:
products:
models:

Deliverables

Description	*End Date*	*IBPD Metric #*
Final report	9/30/2007	

Notes: Project is in support of the NACP

Project: CCIWG activities

Support for user workshops and other activites with impacts on carbon management program planning.

Budget ($K)

FY07	40
FY08	50
FY09	50
FY10	60
FY11	60

Project Monitor/ Center	*Other NASA Centers*	*Timeframe*	*Partners*
Ed Sheffner HQ		FY07 - FY07	

Principal Investigator(s): TBD

Other Apps.

Earth Science Products

mission:
sensor:
products:
models:

Deliverables

Description	*End Date*	*IBPD Metric #*
Workshop completed	12/1/2007	

Notes:

Project: Carbon Management through the GES Network

Joint solicitation with USDA/CSREES and NOAA to extend Geospatial Extension Specialist program to additional states and support existing programs for enahncement of local to regional decison suppor tools with NASA climate and weather modeling and other capabilities.

Budget ($K)

FY07	25
FY08	150
FY09	150
FY10	150
FY11	150

Project Monitor/ Center	*Other NASA Centers*	*Timeframe*	*Partners*
Ed Sheffner HQ	ARC, GSFC, SSC	FY07 - FY11	NOAA, USDA/CSREES, USGS

Principal Investigator(s)

Other Apps.

Earth Science Products

mission:
sensor:
products:
models:

Deliverables

Description	*End Date*	*IBPD Metric #*

Notes:

Project: Framework for Carbon Accounting				Carbon Cycle Science	
Potential augmentation to existing project based on progress through FY07. Extension will cover validation and benchmarking with user organization. See record on solicted project for West for more information.				*Budget ($K)*	
				FY07	0
Project Monitor/ Center	*Other NASA Centers*	*Timeframe*	*Partners*	FY08	175
Ed Sheffner HQ	ARC	FY06 - FY09		FY09	175
				FY10	0
				FY11	0
Principal Investigator(s)		*Tris West - ORNL*		*Other Apps.*	
Earth Science Products	mission: sensor: products: models:				
Deliverables	*Description*		*End Date*	*IBPD Metric #*	
Notes:					

Project: Augment solicitations

Funding to augment solicited projects, as needed, or initiate directed projects to meet programmatic objectives.

Budget ($K)	
FY07	0
FY08	0
FY09	30
FY10	290
FY11	512

Project Monitor/ Center	*Other NASA Centers*	*Timeframe*	*Partners*
Ed Sheffner HQ		FY09 - FY11	

Principal Investigator(s)

Other Apps.

Earth Science Products

mission:
sensor:
products:
models:

Deliverables

Description	*End Date*	*IBPD Metric #*

Notes:

C. Congressionally-Directed Activities

The program oversees Congressionally-directed activities associated with carbon management issues. The project teams for Congressionally-directed activities are responsible for developing, managing, and reporting on technically-credible and appropriately-budgeted projects aligned with the NASA Applied Sciences Program objectives. The Carbon Management program team interacts with the recipients to align their activities appropriately and facilitates interaction with the program's partners and other investigators.

There are no congressionally directed projects at this time.

V. Program Management & Crosscutting Solutions Support

A. Program Management Activities

The Carbon Management program conducts activities that contribute to the overall management, advocacy, and success of the program. Activities include studies and assessments in informal planning, interagency working group participation, publications and journal articles, support for conferences and workshops, program team meetings, and other related endeavors.

<table>
<tr><td colspan="4">Project: Program Element Team Meeting</td><td colspan="2">Project Management</td></tr>
<tr><td colspan="4">Annual meeting to review and discuss program elements goals and objectives.
Participants will include all funded PIs in the the propgram element and others.</td><td colspan="2" rowspan="2">Budget ($K)
FY07 20</td></tr>
<tr><td>Project Manager</td><td>Centers</td><td>Timeframe</td><td>Partners</td></tr>
<tr><td rowspan="4">Ed
Sheffner
HQ</td><td rowspan="4">ARC, GSFC, SSC, GISS, JSC, JPL</td><td rowspan="4">FY07 - FY11</td><td rowspan="4">University of Arizona</td><td>FY08</td><td>25</td></tr>
<tr><td>FY09</td><td>25</td></tr>
<tr><td>FY10</td><td>25</td></tr>
<tr><td>FY11</td><td>25</td></tr>
<tr><td colspan="3">Principal Investigator(s)</td><td></td><td colspan="2" rowspan="2">Other Apps.</td></tr>
<tr><td>Earth Science Products</td><td colspan="3">mission:
sensor:
products:
models:</td></tr>
<tr><td>Deliverables</td><td colspan="3"><u>Description</u> <u>End Date</u> <u>IBPD Metric #</u></td><td colspan="2">Agricultural efficiency, invasive species, ecological forecasting</td></tr>
<tr><td colspan="6">Notes:</td></tr>
</table>

Project: Program Management

Assistance with program element administration.

Budget ($K)

FY07	50
FY08	50
FY09	50
FY10	50
FY11	50

Project Manager	*Centers*	*Timeframe*	*Partners*
Ed Sheffner HQ	ARC	FY07 - FY11	USDA, USGS, NSF, DOE, NIST, EPA

Principal Investigator(s): *Vern Vanderbilt - ARC*

Other Apps.

Earth Science Products

mission:
sensor:
products:
models:

Deliverables

Description	*End Date*	*IBPD Metric #*

Notes:

Project: Support for conferences related to carbon management

Project Manager	*Centers*	*Timeframe*	*Partners*	*Budget ($K)*	
				FY07	10
Ed Sheffner HQ		FY07 - FY11		FY08	20
				FY09	20
				FY10	20
				FY11	20

Principal Investigator(s)		*Other Apps.*
Earth Science Products	mission: sensor: products: models:	
Deliverables	*Description* / *End Date* / *IBPD Metric #*	

Notes:

B. Crosscutting Solutions Support

The Carbon Management program works with the Crosscutting Solutions Element within the Applied Sciences Program to develop project concepts and enable objectives. The program expects to pursue the following activities with the four Crosscutting Solutions sub-elements:

Integrated Benchmark Solutions

FY07:

FY08:

FY09:

FY10:

FY11:

Solutions Networks

DEVELOP

FY07:

FY08:

FY10:

GIO

FY07:

FY08:

FY09:

FY10:

FY11:

VI. Budget: FY07-11

The following table lists the Carbon Management Program budget for FY2007 - FY2011

Project	FY07 ($K)	FY08 ($K)	FY09 ($K)	FY10 ($K)	FY11 ($K)
Linking Landscape Scale Carbon Monitoring and Forest Management	379	224	0	0	0
Decision Support for Loblolly Pine Carbon Management: From Research to Operations	652	652	0	0	0
Projections of Land Use Change and the Carbon Cycle	142	81	90	0	0
Decision Support for Carbon management Across the US Corn Belt	224	0	0	0	0
Accounting for CO2 Fluxes in Agricultural Lands	80	275	250	0	0
Spatially Explicit Full Carbon and Greenhouse Gas Accounting at the Regional to National Scale	200				
North American Forest Distrubance and Regrowth		246	375	375	
Global Land Cover Facility	0				
Roses II Ocean Carbon solicitation		500	500	500	
ROSES III-V for Carbon Management			500	1000	1500
Carbon Cycle Science solicitation		1000	1000	1000	1000
Analysis of ecosystem processes for NACP using satellite data and simulation models	294	284	294		
LEDAPS-Forest Disturbance	283	0	0	0	0
The Utility of OCO Data to Enhance Decision Support Tools	25	0	0	0	0
Augmentation for Forest Disturbance and Re-growth	50	0	0	0	0
CCIWG activities	40	50	50	60	60
Carbon Management through the GES Network	25	150	150	150	150
Framework for Carbon Accounting	0	175	175	0	0

Augment solicitations	0	0	30	290	512
Program Element Team Meeting	20	25	25	25	25
Program Management	50	50	50	50	50
Support for conferences related to carbon management	10	20	20	20	20
Total = $	**2474**	**3732**	**3509**	**3470**	**3317**

VII. Schedule and Milestones for Carbon Management

Project	*Start Date*	*Deliverable*	*End Date*
Linking Landscape Scale Carbon Monitoring and Forest Management	FY05	Evaluation Report	6/1/2007
		Verification & Validation	12/1/2007
		Benchmark Report	6/1/2008
		Complete initial estimates of	12/1/2006
		Link models to multiscale data	12/1/2006
		Link models to multiscale data	11/1/2006
		Evaluation of existing forest	2/1/2008

Project	*Start Date*	*Deliverable*	*End Date*
Decision Support for Loblolly Pine Carbon Management: From Research to Operations	FY06	Evaluation Report	12/1/2006
		Verification & Validation	12/1/2007
		Benchmark Report	2/1/2009

Project	*Start Date*	*Deliverable*	*End Date*
Projections of Land Use Change and the Carbon Cycle	FY05	Progress Report	3/1/2007
		Progress Report	3/1/2008
		Evaluation Report	6/1/2007
		V and V of carbon model output	11/1/2008
		Benchmark EPA usage	12/1/2009

Project	*Start Date*	*Deliverable*	*End Date*
Decision Support for Carbon management Across the US Corn Belt	FY05	Final report on DST potential	2/1/2008

Project	*Start Date*	*Deliverable*	*End Date*
Accounting for CO2 Fluxes in Agricultural Lands	FY05	Progress report	5/1/2007
		Progress report	5/1/2008
		Evaluation Report	6/1/2008
		Verification & Validation	6/1/2009
		Benchmark Report	4/1/2010

Project	*Start Date*	*Deliverable*	*End Date*
Spatially Explicit Full Carbon and Greenhouse Gas Accounting at the Regional to National Scale	FY05	Progress Report	3/1/2007

Project	*Start Date*	*Deliverable*	*End Date*
North American Forest Distrubance and Regrowth	FY05	Progress Report	2/1/2007
		Project evaluation prior to	9/30/2007
		Evaluation Report	12/1/2007
		Verification & Validation	12/1/2008
		Benchmark Report	12/1/2009

Project	*Start Date*	*Deliverable*	*End Date*
Global Land Cover Facility	FY04	Final Report	2/1/2007

Project	*Start Date*	*Deliverable*	*End Date*
Roses II Ocean Carbon solicitation	FY08		

Project	*Start Date*	*Deliverable*	*End Date*
ROSES III-V for Carbon Management	FY09		

Project	*Start Date*	*Deliverable*	*End Date*
Carbon Cycle Science solicitation	FY08		

Project	*Start Date*	*Deliverable*	*End Date*
Analysis of ecosystem processes for NACP using satellite data and simulation models	FY07	Initial TOPS run for N. America	9/30/2007
		Uncertainty estimates	9/30/2008
		Validation of model results	6/1/2009
		Final TOPS implementation for	9/30/2009

Project	*Start Date*	*Deliverable*	*End Date*
LEDAPS-Forest Disturbance	FY04	Final report on LEDAPS	9/30/2007

Project	*Start Date*	*Deliverable*	*End Date*
The Utility of OCO Data to Enhance Decision Support Tools	FY06	Rapid prototype model	7/1/2007

Project	*Start Date*	*Deliverable*	*End Date*
Augmentation for Forest Disturbance and Re-growth	FY07	Final report	9/30/2007

Project	*Start Date*	*Deliverable*	*End Date*
CCIWG activites	FY07	Workshop completed	12/1/2007

Project	*Start Date*	*Deliverable*	*End Date*
Carbon Management through the GES Network	FY07		

Project	*Start Date*	*Deliverable*	*End Date*
Framework for Carbon Accounting	FY06		

Project	*Start Date*	*Deliverable*	*End Date*
Augment solicitations	FY09		

Project	*Start Date*	*Deliverable*	*End Date*
Program Element Team Meeting	FY07		

Project	*Start Date*	*Deliverable*	*End Date*
Program Management	FY07		

Project	*Start Date*	*Deliverable*	*End Date*
Support for conferences related to Carbon Management	FY07		

VIII. Program Measures

The Carbon Management Program Element team uses performance measures to track progress, identify issues, evaluate projects, make adjustments, and establish results of the Program Element. The program's Goals and Objectives (Section II) state planned achievements. These measures help monitor progress within and across specific activities to ensure the program meets its goals and objectives. The management team analyzes these measures retrospectively in order to made adjustments proscriptively to the program approach and objectives.

The measures are in two categories. Program management measures are internally focused to assess the activities within the program. Performance measures are externally focused to assess if the program activities are serving their intended purpose. In general, the Program Manager uses these measures to evaluate the performance of activities conducted and sponsored by the Program, especially the projects. In addition, the Science Mission Directorate uses this information in preparing IBPD directions and PART responses.

Program Management Measures (Internal):
Inputs:
1) Potential issues and DSTs identified for carbon management - number, type, range
2) Eligible partners to collaborate with - number, type, range
3) Potential results/products identified to serve carbon management - number, type, range

Outputs:
1) Assessments or evaluations of DSTs - number, range
2) Assessments of Earth-Sun science results/products to serve DSTs - number, range
3) Agreements with partners - presence
4) Reports (evaluation, validation, benchmark) - number, type

Quality and Efficiency:
1) Earth Science science results/products - number used per DST, ratio of utilized to potential
2) Agreements - ratio of agreements to committed partners
3) Reports - partner satisfaction, timeliness, time to develop
4) Reports - ratio of validations to potential products, ratio of benchmarks to validations

Performance and Results Measures (External):

Outcomes:
1) Earth Science science products adopted in DSTs - number, type, range; use in DST over time
2) Earth Science science products in use - ratio of products used by partners to reports produced
3) Partner and DST performance - change in partner DST performance, number and type of public recognition of use and value of Applied Science observatioins in DST

Impacts:
1) Partner value - change in partner metrics (improvements in value of partner decisions)

In addition to the stated measures, the Carbon Management Program Element Manager periodically requests an assessment of its plans, goals, priorities, and activities through external review. The Carbon Management Program Element Team uses these measures along with comparisons to programmatic benchmarks to support assessments of the Science Mission Directorate (e.g. internal NASA reviews and OMB PART).

Appendix A: Program Element Partners

A. Program Management

Program Manager
Carbon Management Element
Mr. Ed Sheffner
Applied Sciences Program
Earth Science Division
NASA Headquarters

Responsibilities:

- Development of and implementation of interagency agreements and partnerships with other organizations.
- Program development including program plans and budgets.
- Development and implementation of solicitations for carbon management tasks.
- Primary responsibility for metrics, performance goals and other performance evaluation criteria.

- Point of contact for CCTP working group on sequestration, NASA/Earth Science Division carbon program (for applications), and NASA/USDA focus area working group on carbon management.
- Applied Science representative on Carbon Cycle Interagency Working Group (CCIWG).
- Member of the Agency Executive Committee for the State of the Carbon Cycle Report (SOCCR) - Synthesis and Assessment Report (SAR2.2) of the Climate Change Science Program.
- Monitor projects within the program element and collaborate with the principal investigators and the carbon management community to assure that the goals and objectives of the program element are responsive to community needs and goals and objectives of the Applied Sciences Program.

Deputy Program Manager
Carbon Management Element
Dr.Vern Vanderbilt
Earth Science Division
NASA Ames Research Center

Responsibilities:

- Coordinate and liaison with Program Element Management for Carbon Management tasks at NASA Centers other than Stennis.
- COTR or studies manager (as appropriate) for grants and cooperative agreements related to carbon management and funded by the Earth Science Applications Division through procurement at SSC.

- Monitor the progress of projects within the program element. First point of contact for principal investigators within the program element.

B. Carbon Management Network & Partners

The program element maintains a network of organizations and points-of-contact associated with carbon management activities.

NASA HQ partners:

Chair: Carbon and Ecosystems Focus Area…….....Diane Wickland
Program Manager for Ocean Processes: Earth Science Research Program
……..... Paula Bontempi
Program Manager for Ecological Forecasting: Applied Sciences Program
……..... Woody Turner
Program Manager for Water Management: Applied Sciences Program
……..... Jared Entin
Program Manager for Air Quality: Applied Sciences Program
……..... Lawrence Friedl
Program Manager for Disaster Management: Applied Sciences Program
……..... Stephen Ambrose
IPA: Terrestrial Processes …….....William Emanuel

NASA Centers:

ARC:
Dr. Chris Potter and Dr. Ramakrishna Nemani, Modeling of carbon sequestration; enhancement of decision support tools for carbon emissions and sequestration

GSFC:
Dr. Jeff Masek, Calibration of MODIS and Landsat datasets to exploit extended record of Landsat for land cover change and its impact on carbon cycling and carbon management

Johnson Space Center (JSC):
Dr. Kamlesh Lulla, Coral reef studies – link to oceanic sources and sinks

Marshall Space Flight Center (MSFC):
Dr. Steve Goodman, Climate studies and forecasting; impact of climate change on source and sink dynamics

Partner agency contacts:

USDA:
Bill Hohenstein, Global Change Program Office
USDA/Forest Service: Richard Birdsey, US Forest Service, chair, carbon management focus area working; Sequestration Working Group for CCTI; Chip Scott, Forest Inventory and Analysis (FIA) program
USDA/ARS: Paul Doriaswamy, Agricultural practices and soil carbon
USDA/NRCS: Jeff Goebel and John Brenner, carbon flues in agrciultrual land

EPA:
Ken Andrasko, Sequestration Team, Office of Atmospheric Programs
Tim Worth, carbon fluxes in agriculture

DOE:
Jeff Amthor, Climate Change Research Division, Germantown, MD
Dr. Roger Dahlman, Lead in CCTI; Measurement, Monitoring and Verification Working Group for CCTI; lead agency for implementation of 1605(b) guidelines

DOE/CSITE:
Craig Brandt, carbon accounting

DOE/ORNL:
Dr. Tris West, Carbon accounting
Dr. Tom Wilbanks, carbon management
Dr. Robert Cook, carbon data distribution

USGS:
Dr. Tom Loveland, Land cover and land cover change information for carbon sequestration

EPA:
Dr. Jane Leggett

Universities contacts:

Colorado State University (CSU):
Dr. Ingrid Burke, Impact of wild fires on carbon cycling and carbon sequestration
Dr. Keith Paustian, carbon fluxes in agrciulture
Dr. Richard Conant, carbon fluxes in agrciulture
Dr. Stephen Ogle, carbon sequestration in soils
Dr. Dennis Ojima, carbon fluxes

MSU:
Dr. Roger King, Forest structure visualization; monitoring carbon accumulation in forest biomass and soils
University of Georgia (UG):
Dr. Ed Kanemasu, Agricultural decision support and carbon sequestration in
developing countries

University of Maryland (UM):
Dr. David Roy, Impact of fires on carbon sequestration
Dr. Joseph JaJa, Distribution of data products
Paul Davis, Distribution of carbon products

Virginia Polytechnic University:
Dr. Randy Wynne: Decision support for carbon management

California State University Monterey Bay:
Venessa Genovese, Steven Klooster, Carbon modeling and predictive tools

Pennsylvania State University:
Dr. Klaus Keller, Carbon management and land use change

University of Illinois:
Dr. Atul Jain, carbon management and land use change

University of Tennessee:
Tools for full carbon accounting

Other Organizations:

Conservation International:
Dr. Marc Steininger, Fires in tropical forests

UNEP:
Dr. Ashbindu Singh

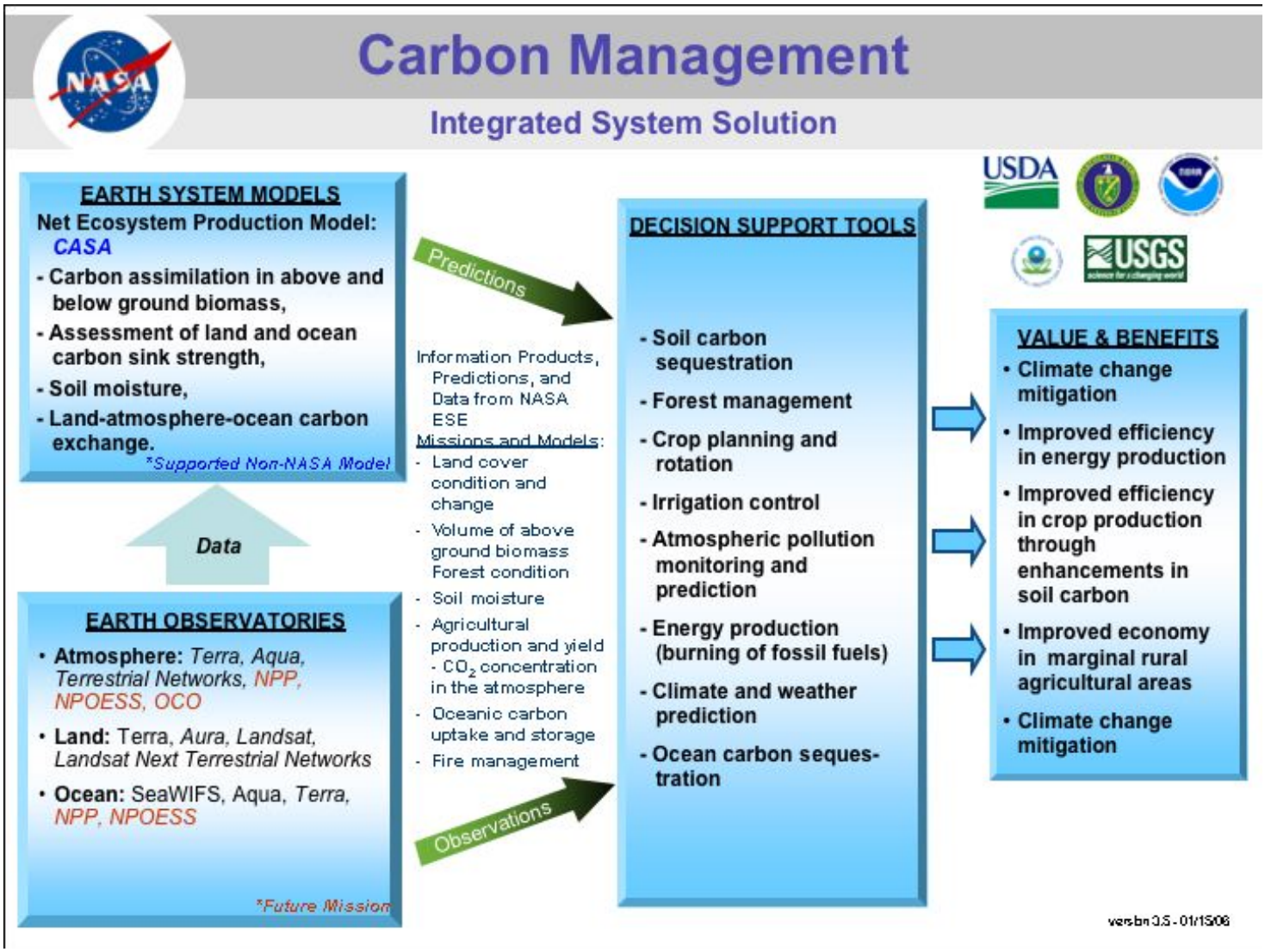
DAACS and Earth Science Modeling Center Partners:

Land Processes DAAC
Oak Ridge national Laboratory DAAC
Socioeconomic Data and Applications Center (SEDAC)

Appendix B: Roadmaps

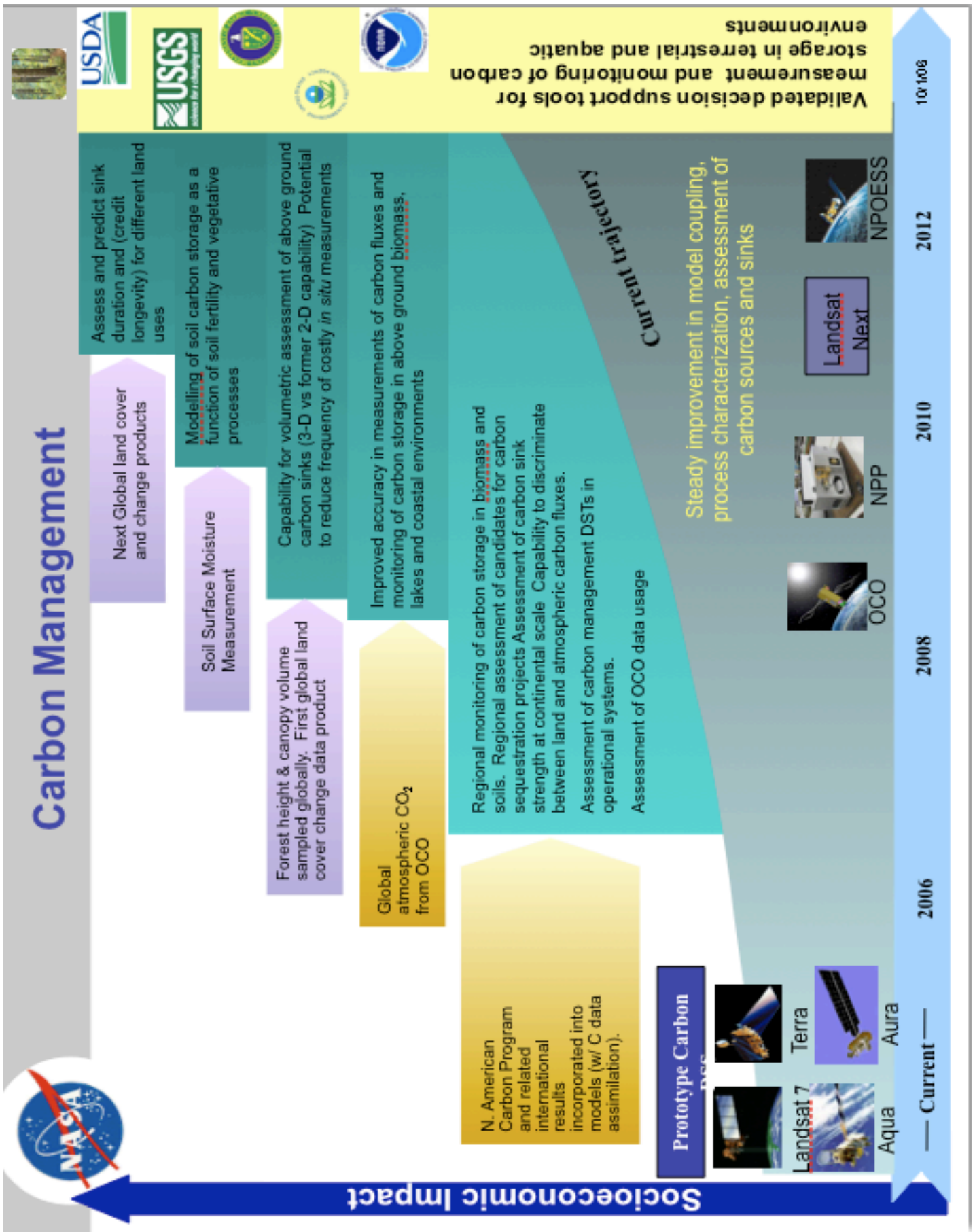
A. Integrated System Solutions Diagram

The figure below illustrates how Science measurements, model products, and data fusion techniques support the Carbon Management Program's partners and their decision support tools and shows the value and benefits of Science to society.



B. Roadmap

The Carbon Management Program draws upon, and contributes to, the Carbon Science Program of the Earth Science Division. NASA/Earth Science Division-sponsored science supporting climate, weather and natural hazards objectives will generate observations, models and technology that are the primary contributions of the Carbon Management Program to Carbon Management decision support tools and systems. The roadmaps for Carbon Science and Carbon Management are similar - as illustrated below. The major milestones of the science program, such as the introduction of OCO observations and the impact that will have on understanding the flux of carbon among land, ocean and atmosphere, are also milestones for the Carbon Management Program. These roadmaps illustrate the anticipated major objectives and timing for the program in the next ten to fifteen years. The roadmaps were updated in September 2004. Figure 4. Carbon Science Roadmap


Carbon Management
Validated decision support tools for measurement and monitoring of carbon storage in terrestrial and aquatic environments
Assess and predict sink duration and (credit longevity) for different land uses
Next Global land cover and change products
Modelling of soil carbon storage as a function of soil fertility and vegetative processes
Soil Surface Moisture Measurement
Capability for volumetric assessment of above ground carbon sinks (3-D vs former 2-D capability) Potential to reduce frequency of costly in situ measurements
Forest height & canopy volume sampled globally. First global land cover change data product
Improved accuracy in measurements of carbon fluxes and monitoring of carbon storage in above ground biomass, lakes and coastal environments
Global atmospheric CO_2 from OCO
Regional monitoring of carbon storage in biomass and soils. Regional assessment of candidates for carbon sequestration projects Assessment of carbon sink strength at continental scale Capability to discriminate between land and atmospheric carbon fluxes.
Assessment of carbon management DSTs in operational systems.
Assessment of OCO data usage
N. American Carbon Program and related international results incorporated into models (w/ C data assimilation).
Current trajectory
Steady improvement in model coupling, process characterization, assessment of carbon sources and sinks
Prototype Carbon
OCO
NPP
Landsat Next
NPOESS
Landsat 7
Terra
Aqua
Aura
— Current —
2006
2008
2010
2012
Socioeconomic Impact
USDA
USGS

Appendix C: Acronyms

AIRS	Airborne Infrared Sounder
AIWG	Applications Implementation Working Group
ALI	Advanced Land Imager
AMSR-E	Advanced Microwave Scanning Radiometer-EOS (Japanese)
ARC	Ames Research Center
ARS	Agricultural Research Service
ATBD	Algorithm Technical Basis Documents
AVHRR	Advanced Very High Resolution Radiometer
CANMET	Canadian Meteorological Service
CASA	Carnegie-Ames-Stanford Approach
CCIWG	Carbon Cycle Interagency Working Group
CCRI	Climate Change Research Initiative
CCSP	Climate Change Science Program
CCTI	Climate Change Technology Initiative
CCTP	Climate Change Technology Program
CERES	Clouds and the Earth's Radiant Energy System
CO	Carbon Monoxide
CO2	Carbon Dioxide
COLE	Carbon On-Line Estimator
COTR	Contracting Officer's Technical Representative
CQUEST	Carbon Query and Evaluation Support Tools
CSREES	Cooperative State Research, Education and Extension Service
CSU	Colorado State University
DAAC	Distributed Active Archive Center (Data Active Archive Center)
DOA	US Department of Agriculture
DOC	US Department of Commerce
DOE	US Department of Energy
ENSO	El Niño - Southern Oscillation
EOS	Earth Observing Systems
EPA	US Environmental Protection Agency
EPACT	Energy Policy Act of 1992
EROS	Earth Resources Observation System
ETM+	Enhanced Thematic Mapper Plus
EVI	Enhanced Vegetation Index
FEA	Federal Enterprise Architecture
FIA	Forest Inventory and Analysis
FPAR	Fraction of Absorbed Photosynthetically Active Radiation
FS	Forest Service
FTE	Full Time Equivalent
FV	Forest Visualization System
FWRC/GRI	Forest and Wildlife Research Center
GCM	Global Climate Model
GIG	Global Information Grid
GRI	Global Reporting Initiative/Geospatial Research Institute

GSFC	Goddard Space Flight Center
IBPD	Integrated Budget and Performance Document
IPA	Independent Pixel Approximation
IPCC	International Panel on Climate Change
ISCCP	International Satellite Cloud Climatology Project
IWGEO	Interagency Working Group on Earth Observations
JCSDA	Joint Center for Satellite Data Assimilation
JSC	Johnson Space Center
LaRC	Langley Research Center
LDAS	Land Data Assimilation System
LEDAPS	Landsat Ecosystem Disturbance Adaptive Processing System
LIDAR	Light Detecting and Ranging
MISR	Multi-angle Imaging Spectro-Radiometer
MODAPS	MODIS Data Processing System
MODIS	Moderate Resolution Imaging Spectroradiometer
MOPITT	Measurements Of Pollution In The Troposphere
MSFC	Marshall Space Flight Center
MSS	Multi-Spectral Scanner (Landsat 1)
MSU	Mississippi State University
NACP	North American Carbon Program
NASA HQ	NASA Headquarters
NASA	National Aeronautics and Space Administration
NCAR	National Center for Atmospheric Research
NDVI	Normalized Difference Vegetation Index
NESDIS	National Environmental Satellite Data Information Service
NGO	Non Governmental Organization
NPP	NPOESS Preparatory Project/Net Primary Productivity
NOAA	National Oceanic and Atmospheric Administration
NSF	National Science Foundation
NWS	National Weather Service
OAR	Office of Oceanic and Atmospheric Research
OCO	Orbiting Carbon Observatory
OMB	Office of Management and Budget
OSSE	Observing System Simulation Experiment
OSTP	Office of Science and Technology Policy
PART	Program Assessment Rating Tool
R2O	Research to Operations Network
RAQMS	Regional Air Quality Modeling system
RSTC	Remote Sensing Applicability with Transportation
SAR	Synthesis and Analysis Report
SDP	Scientific Data Purchase
SEA	State Enterprise Architecture
SSC	Stennis Space Center
TM	Thematic Mapper
TOPS	Terrestrial Observation and Prediction System
UCAR	University Corporation for Atmospheric Research

UGA	University of Georgia
UM	University of Maryland
USDA	US Department of Agriculture
USFS	US Forest Service
USGCRP	US Global Change Research Program
USGS	United States Geological Survey
WUR	Wood Utilization Research

NASA Science Mission Directorate
Earth Science Division - Applied Science Program
Carbon Management Program Element

This document contains the Carbon Management Program Element Plan for FY 2007-2011.

This plan derives from direction established in the NASA Strategic Plan, Earth Science Enterprise and Space Science Enterprise Strategies, Earth Science Applications Plan, and OMB/OSTP guidance on research and development. The plan aligns with and serves the commitments established in the NASA Integrated Budget and Performance Document.

The Program Manager and the Applied Sciences Program Leadership have reviewed the plan and agree that the plan appropriately reflects the goals, objectives, and activities for the Program Element to serve the Applied Sciences Program, Earth Science Division, NASA, the Administration, and Society.

Ed Sheffner
Program Manager, Carbon Management
Applied Sciences Program
NASA Earth Science Division

Date

Lawrence Friedl
Lead, National Applications
Applied Sciences Program
NASA Earth Science Division

Date

Teresa Fryberger, PhD.
Director, Applied Sciences Program
NASA Earth Science Division

Date